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The relationship between passive smoking and hypertension in adults and the elderly In Dimong Village, Madiun District, Madiun Regency, East Java, Indonesia

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Abstract

Background: In Dimong Village, Madiun Regency, East Java, Indonesia, showed a hypertension prevalence of 40%, higher than the national. Passive smoking is a risk factor for hypertension, and 41.7% suffer from hypertension. However, sometimes passive smokers have lower resting blood pressure. What is the relationship between passive smoking status and the incidence of hypertension? This study aims to determine the relationship between the two.

Methods: This cross-sectional study was conducted in Dimong Village. A total of 94 individuals aged 18 years and over were selected as respondents using simple random sampling and met the sample criteria. The study variables consisted of passive smoking and hypertension. In addition to blood pressure measurements using a digital sphygmomanometer, respondents were also interviewed to determine whether their status as passive smokers was related to their hypertension using a questionnaire. The data obtained were then analyzed using a chi-square test to determine the relationship between the two variables.

Results: The incidence of passive smoking remains high (81.91%), particularly among those aged 61-70, women, those with low levels of education, and those who are unemployed (housewives). Similarly, the incidence of hypertension remains high (52.12%), with similar characteristics, but is more prevalent among those who have graduated from high school or its equivalent. The probability value of the association between passive smoking and hypertension is 0.162.

Conclusion: Passive smoking is not associated with hypertension. Similar research is needed, taking into account the distribution of passive smoking and the more varied incidence of hypertension.

Keywords: Passive Smoking; Hypertension; Adults and Elderly; Dimong Village; Madiun; Indonesia

1. Introduction

Hypertension is a chronic disease commonly found in adults and the elderly. This disease is a global health problem and is a leading cause of death and disability.(1) A preliminary study in Dimong Village, Madiun Regency, East Java, Indonesia, showed a hypertension prevalence of 40%, higher than the national rate (34.1%) and East Java (36%) according to the 2018 Basic Health Research (Riskesdas). In East Java, the hypertension rate increased from 26.2% to

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36% during the same period. Despite the availability of treatment, less than half of patients achieve normal blood pressure.(2)

Smoking is a major modifiable risk factor for hypertension.(3) Nicotine stimulates the release of the hormones epinephrine and norepinephrine, which cause blood vessel constriction and increase heart rate and blood pressure. Long-term smoking damages artery walls, triggering the formation of atherosclerotic plaque and narrowing of blood vessels, further increasing blood pressure. The same situation is found in passive smokers or individuals exposed to secondhand smoke (SHS).

Akpa et al. (2021) reported a higher prevalence of hypertension in individuals exposed to secondhand smoke, both young and elderly.(4) Zhang et al. (2021) noted that high levels of SHS exposure increased the risk of hypertension by 13%, with a dose-response pattern where the higher the exposure, the greater the risk.(5) Similar findings were presented by Cao et al. (2024),(6) (6) and Tamura et al. (2018), who stated that the risk of hypertension due to SHS was more pronounced, especially in men.(5)

However, evidence also found that those who are active smokers have lower resting blood pressure than non-smokers, although this observation is inconsistent and does not apply to passive smokers, because active smokers can develop tolerance to the effects of nicotine.(7) In Dimong Village, 41.7% of hypertension sufferers are passive smokers. What is the relationship between passive smoking status and the prevalence of hypertension in the community in Dimong Village, Madiun District, Madiun Regency in 2025? This study aims to determine the relationship between passive smoking status and the prevalence of hypertension in passive smokers in Dimong Village.

2. Methods

This cross-sectional study was conducted in Dimong village, Madiun Regency, East Java, Indonesia. Ninety-four individuals aged 18 and over were selected as respondents using simple random sampling and met the criteria of not having communication disorders, severe mental disorders, smoking, non-communicable diseases, or being pregnant.

The sample size was determined using the formula of Lemeshow et al., 1990,(8) with a confidence level of 95%, the prevalence of hypertension in the passive smoker population based on preliminary research of 58.3% and an acceptable error of 10%. Informed consent was obtained from all individual participants included in the study. Hypertensive respondents were those with systolic blood pressure of >140 and/or diastolic blood pressure of >90 mmHg and/or a history of hypertension diagnosis and/or antihypertensive treatment. In addition to blood pressure checks with a digital sphygmomanometer, respondents were also interviewed to determine their status as passive smokers or not, also related to their hypertension condition, using a questionnaire adapted from the Indonesian Ministry of Health's Riskesdas 2018. Furthermore, the data obtained were analyzed using the chi-square test to determine the relationship between the two variables.

3. Results

The average age of respondents was 54.62 years, with the majority being 70 years old, with the oldest being 83 and the youngest being 19. Those older had low levels of education. Similarly, the majority of those older (over 60) were farmers (Table 1).

Passive smoking and hypertension were more common among older individuals (Table 2) and among those with hypertension, women were more likely to be female (Table 3). Meanwhile, those who were passive smokers and had hypertension were more likely to have low levels of education. The analysis of the relationship between passive smoking status and hypertension showed no significant association (p=0.162) (Table 4).

Table 1 Frequency Distribution in Percent of Respondents' Education Level and Occupation Based on Respondent's Age

Age (Year)	Education Level				Occupation			
	Low		High		No		Yes	
	n	%	n	%	n	%	n	%
19 - 30	2	3.4	11	31.4	9	14.5	4	12.5
31 - 40	5	8.5	15	42.9	15	24.2	5	15.6
41 - 50	14	23.7	4	11.4	13	20.9	5	15.6
51 - 60	9	15.3	4	11.4	8	12.9	5	15.6
61 - 70	21	35.6	1	2.9	12	19.4	10	31.3
71 - 80	7	11.9	0	0	5	8.1	2	6.3
81 - 90	1	1.7	0	0	0	0	1	3.1
Total	59	100	35	100	62	100	32	100

Table 2 Frequency Distribution in Percent of Passive Smoking and Hypertension Based on Respondent's Age

Age (Year)	Passive Smoker				Hypertension			
	No		Yes		No		Yes	
	n	%	n	%	n	%	n	%
19 - 30	6	35.3	7	9.1	10	22.2	3	6.1
31 - 40	2	11.8	18	23.4	12	26.7	8	16.3
41 - 50	1	5.9	17	22.1	6	13.3	12	24.5
51 - 60	2	11.8	11	14.3	4	8.9	9	18.4
61 - 70	3	17.6	19	24.7	8	17.8	14	28.6
71 - 80	3	17.6	4	5.2	4	8.9	3	6.1
81 - 90	0	0	1	1.3	1	2.2	0	0
Total	17	100	77	100	45	100	49	100

Table 3 Frequency Distribution in Percent of Passive Smoking and Hypertension Based on Respondent Characteristics

Characteristic	Passive Smoker				Hypertension			
	No		Yes		No		Yes	
	n	%	n	%	n	%	n	%
Sex: Man	2	11.8	13	16.9	8	17.8	7	16
Woman	15	88.2	64	83.1	37	82.2	42	84
Education Level: Low	7	41.2	52	67.5	25	55.6	34	69.4
High	10	58.8	25	32.5	20	44.4	15	30.6
Occupation: No	14	82.4	48	62.3	31	68.9	31	63.3
Yes	3	17.6	29	37.7	14	31.1	18	36.7

Table 4 Frequency Distribution in Percent of Blood Pressure in Passive Smokers and Proportional Value of the Relationship

	Hypertension				
Passive Smoker	**Yes**		**No**		**p-value**
	n	**%**	**n**	**%**	
Yes	46	86.8	31	75.6	0.162
No	7	13.2	10	24.4	
Total	53	100	41	100	

4. Discussion

4.1. Hypertension

The 61–70 age group shows the highest number of hypertension cases. This finding aligns with previous studies that suggest the prevalence of hypertension increases with age. This increase is caused by various factors, including natural physiological changes that occur in older adults and a less active or unhealthy lifestyle. With age, blood vessels lose elasticity and become stiffer, reducing the ability of their walls to contract and relax. This results in increased blood pressure because blood flow cannot be accommodated optimally.(5)

Another study by Rahmad and Laila (2021) also showed a significant relationship between age over 45 years and the incidence of hypertension (p=0.001), which indicates that advanced age is closely correlated with increased blood pressure due to changes in vascular permeability and decreased kidney function.(9) Systolic blood pressure (SBP) experiences a consistent increase with age, while diastolic blood pressure (DBP) tends to peak at around 40 years of age and decreases after entering old age.(10)

Cheng et al. (2022) found that systolic blood pressure increased linearly with age in men, while in women the pattern of increase was non-linear.(11) This suggests that age-related physiological changes play a significant role in the development of hypertension. One significant change that occurs with aging is decreased blood vessel elasticity. This condition leads to increased systolic blood pressure due to increased resistance in peripheral blood vessels. Furthermore, the aging process also impacts kidney function and disrupts blood pressure-regulating systems such as the renin-angiotensin-aldosterone system, thus impairing the body's ability to maintain stable blood pressure.(12) Meanwhile, data from the Centers for Disease Control and Prevention (CDC) in 2019 showed that the prevalence of hypertension reached 22.4% in the 18–39 age group, increased to 54.5% in the 40–59 age group, and jumped to 74.5% in the 60 and above age group.(13) These findings emphasize that age is one of the main risk factors for hypertension.

Based on gender, the study also showed that hypertension cases were more common in women (84%) than in men. This finding aligns with research by Paul J. Connelly et al. (2022) and Rian Tasalim (2025).(14,15) The consistency of these findings reinforces the idea that gender is a significant factor in the incidence of hypertension. Women, especially after menopause, are more susceptible to hypertension due to decreased estrogen levels, which previously played a protective role in increasing HDL.(16) In addition, economic stress factors and low physical activity also affect women's blood pressure.(17)

Globally, Garovic et al. (2022) reported that approximately 32% of women aged 30–79 years experience hypertension.(18) In Indonesia itself, the prevalence of hypertension is higher in women (36.9%) than in men (31.34%).(19) These findings demonstrate that our study is consistent with existing epidemiological data and theory and emphasize the importance of focusing on the prevention and management of hypertension in women, particularly older adults. In addition to hormonal and lifestyle factors, additional risk factors such as a history of preeclampsia, kidney disease, thyroid disease, and hormonal contraceptive use also need to be considered.(20)

Based on respondents' education levels, our study results indicate that the majority of hypertension cases (69.4%) had low levels of education (less than nine years of education). These results align with research that found hypertension is more common in respondents with lower levels of education. Various studies have shown that education level has a significant relationship with the incidence of hypertension. Individuals with lower levels of education tend to have a

higher prevalence of hypertension than those with higher education. This is related to a lack of knowledge about healthy lifestyles, access to health services, and the ability to understand the importance of blood pressure control.

In several countries, such as China, Brazil, and Colombia, it was found that women with low levels of education had a twofold higher risk of developing hypertension compared to women with higher levels of education. However, for men, this relationship was not always consistent.(21) In the United States, respondents who completed high school had a hypertension prevalence of 47%, which is higher than the prevalence of 38.5% among college graduates. Furthermore, those with lower education levels were also more likely to experience uncontrolled blood pressure.(22)

K Sun et al. (2021) added that low education, particularly at the elementary school level or lower, is associated with a higher risk of hypertension and poorer blood pressure control. This condition is closely related to limited health knowledge, which leads to unhealthy lifestyles such as high-salt diets, lack of physical activity, and low utilization of health services.(23)

Therefore, education level can be an important indicator in hypertension prevention and control strategies. Educational interventions tailored to the community's educational background are essential to increase awareness, healthy lifestyle behaviors, and adherence to blood pressure management.

4.2. Passive Smoking

Based on the respondents' age, passive smoking status in this study showed that exposure was highest in the 61–70 age group (24.7%), with a decline in younger ages. This suggests that passive smoking occurs mostly indoors, with contact with smokers confined to the home.

Data from the 2023 Indonesian Health Survey (IHS) support the finding that exposure to secondhand smoke is quite high in the productive age group and the elderly. Furthermore, the prevalence of smokers smoking indoors also increases with age.(24) These findings suggest that older smokers still tend to smoke indoors, which increases the risk of exposure for family members and others around them. IHS 2023 data show that the elderly still contributes significantly to high levels of secondhand smoke exposure. In fact, approximately 9.7% of older adults (aged over 60) are still active smokers, although data also indicate that older adults are more motivated to quit smoking due to increased awareness of health risks.(25)

The productive age group is the period with the highest levels of exposure to cigarette smoke due to work stress and a social environment that is permissive of smoking. Approximately 25–30% of productive-age workers are exposed to cigarette smoke in the workplace due to suboptimal regulations.(26) Those aged 31–50 years cumulatively account for approximately 45.5% of all passive smokers, reflecting that the social and workplace environments of this age group significantly contribute to the high risk of exposure to secondhand smoke. Thus, exposure to secondhand smoke is not only prevalent among young people but also significant among productive age groups and the elderly. Age plays a significant role in determining exposure risk (including the number of hazardous substances inhaled), both due to individual behavior and the influence of the surrounding social environment.

Based on gender, the study results showed that passive smoking status was predominantly among female respondents (83.1%). This finding is consistent with national data from the 2018 Basic Health Research, which reported that approximately 97% of women were passive smokers, of which approximately 65% were exposed to secondhand smoke at home, as a result of male family members smoking indoors. The 2023 HIS recorded that 23% of women aged 10 and over were exposed to secondhand smoke daily in enclosed spaces, and another 43.1% were occasionally exposed. (24) This fact indicates that women are more vulnerable to passive exposure to cigarette smoke, especially in domestic settings.

This high level of exposure also reflects social norms in Indonesian society, which tend to tolerate smoking in men but restrict it for women, as is the social paradigm in other developing countries. Therefore, gender is a significant factor influencing patterns of exposure to both active and passive cigarette smoke.

Based on respondents' education level, the distribution of passive smokers was highest among high school graduates (27.3%). Groups with lower education levels, such as elementary and junior high school graduates, also showed a significant proportional exposure trend. This pattern indicates that individuals with lower education levels are more likely to be passive smokers than those with higher education levels. This phenomenon aligns with findings from the 2023 IHS, which showed that the prevalence of individuals smoking indoors decreases with increasing education levels.(24)

The results of this study are also supported by a study by Xi Nan et al. (2020), which showed that low education levels are closely associated with a high risk of becoming a passive smoker. Low health literacy, limited access to information, and a permissive social environment toward smoking are the main contributing factors. Thus, education is a crucial variable in determining patterns of passive cigarette smoke exposure in the community.(27)

4.3. The Relationship Between Passive Smoking and Hypertension.

The results of this study indicate no significant association between passive smoking and the incidence of hypertension (p=0.162). The higher number of passive smokers compared to non-smokers reflects the study area's low educational level and social norms that tolerate smoking ubiquitously. Similarly, the average age of respondents, in the young adult range, is not conducive to the development of hypertension; therefore, the results of this study cannot fully describe the relationship between passive smoking and the incidence of hypertension.

The findings of this study contrast with those of Qi Zang (2021), who found that passive smoking is associated with increased blood pressure. Data from the National Health Service (NHANES) indicate that serum cotinine levels (a sensitive indicator of nicotine exposure in SHS) in individuals exposed to SHS are approximately 30 times higher than those not exposed to SHS. Serum cotinine levels in non-smokers reflect the level of SHS exposure, not the number of cigarettes smoked or hours of exposure per day. Nicotine, carbon monoxide, and free radicals contained in cigarette smoke are inhaled and can damage blood vessels, cause narrowing of blood vessels, increase heart work, and increase the risk of high blood pressure.(5) Proving the relationship between passive smoking and hypertension requires proof that high levels of nicotine can cause hypertension.

5. Conclusions

Passive smoking is not associated with hypertension. The higher number of passive smokers (81.91%) reflects the study area's low educational level and social norms that tolerate smoking everywhere. Similarly, the average age of respondents, around young adults (54.6 years), is not conducive to hypertension. Hypertension and passive smoking are more common in the 61-70 age group, suggesting that it is not the duration of exposure to cigarette smoke that is the cause, but rather the high levels of harmful substances in inhaled cigarette smoke that cause hypertension.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors declare no conflict of interest.

Statement of ethical approval

This study had received ethical clearance from the Ethics Committee for Health Research, Universitas Airlangga, Surabaya, Indonesia (No. 49/EC/KEPK/FKUA/2025), and the Madiun Regency Health Office under research and extension practice permit number 400.14.5.4/4735/402.102/2025.

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication. All authors contributed to the article and approved the submitted version.

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